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The Equative Construction in Lalo Yi

Abstract: This paper focuses on one particular aspect of Lalo Yi that is not covered in previous work: the morphosyntactic and typological features of its equative construction. There are four different types of equative construction in Lalo Yi (Tibeto-Burman) which are expressed by three different ways: bare adjectives, reduplicative adjectives, and derived nouns. The last two ways are limited to adjectives which express dimensional property. Semantically, the equative meaning can be divided into three types: the ‘exactly’ reading, the ‘at least’ reading and the ‘at most’ reading.

Keywords: Lalo Yi; equative construction; word order

1. Introduction

The equative construction expresses situations in which two referents have a gradable property to the same degree. The equative construction is studied much less extensively than the superior comparative construction. From a crosslinguistic perspective, the major previous studies are Haspelmath and Buchholz (1998), the earliest reference which is restricted to European languages, and Henkelmann (2006), which examines equative construction based on a sample consisting of 25 languages. Haspelmath(2017) is a study of the equative construction with a sample of 119 languages. It distinguishes six primary types: (1) Only equative standard-marker; (2) Equative degree-marker and standard-marker; (3) Equative degree-marker unified; (4) Primary reach equative; (5) Primary reach equative unified; (6) Secondary reach equative. Analysis of the equative construction in specific in Sino-Tibetan languages is scattered in the descriptive grammars or as part of the overall study of comparative constructions, such as, Mandarin Chinese(Li & Thompson 1981), Qiang (Huang 2006), Nuosu Yi (Gerner 2013), Lizu (Chirkova 2018). So far, the equative construction in Lalo Yi is not yet mentioned in descriptive grammars. This paper focuses on one particular aspect of Lalo Yi that is not covered in previous work on this language: the morphosyntactic and typological features of its equative construction. We hope this study will offer empirical data for typological description in the future.

Lalo Yi (Chinese: 腊罗彝语) is a Loloish language in the Yi sub-branch, Tibeto-Burman branch, Sino-Tibetan family, spoken in western Yunnan, China by about 300,000 speakers. Chinese linguists classify Lalo as the western dialect of Yi language with East

Mountain and West Mountain varieties (Chen et. al. 1985) . Lalo Yi is a tonal, head-final and analytic language. Lalo speakers mainly live in Weishan (巍山) , Nanjian (南涧) , yangbi (漾濞) and other adjacent counties in Dali (大理) prefecture, Lincang (临沧) prefecture and Baoshan (保山) prefecture in Yunnan Province . Ancestors of the Lalo people are believed to have resided in the current Weishan area for over two thousand years. So Weishan County is considered to be the traditional homeland of the Lalo people. The data used in this paper were collected from Laoheipeng village, Niujie Town, Weishan County, Dali Prefecture, Yunnan Province (中国云南省大理州巍山县牛街乡老黑棚村).

2. The four types of equative construction in Lalo Yi

Generally speaking, there are five key components in an equative construction, the COMPAREE(the entity being compared) , and the STANDARD (the entity with which the comparee is compared), the PARAMETER (adjective which expresses some gradable property), the STANDARD-MARKER (a marker which is closely associated with the standard), and the DEGREE-MARKER (a marker that is closely associated with the parameter and expresses equality notion).

In this section, the four different types of equative construction in Lalo Yi are described as follows.

2.1. Type 1: COMPAREE + STANDARD + $a^{31}\epsilon y^{31}$ + PARAMETER

- (1)a. $a^{55} ko^{31}$ $a^{33} zi^{33}$ $a^{31}\epsilon y^{31}$ $?mu^{55}$ mu^{31}
Ago Ayi PARTICLE tall EVI
‘Ago is as tall as Ayi.’
- b. $a^{55} ko^{31}$ $a^{33} zi^{33}$ $a^{31}\epsilon y^{31}$ ma^{31} vi^{33} mu^{55} .
Ago Ayi PARTICLE NEG white EVI
‘Ago is not as white as Ayi.’

as shown in (1a), the person name *Ago* stands for the COMPAREE, the other person name *Ayi* encodes as the STANDARD , and the adjective $?mu^{55}$ ‘tall’ is the PARAMETER. As for the particle ‘ $a^{31}\epsilon y^{31}$ ’, it is a complex marker which semantically modifies the main predicate, the gradable adjective $?mu^{55}$ ‘tall’, and introduces the standard of comparison at the same

time. $a^{31}\epsilon y^{31}$ serves as both a degree- and a standard-marker. It is like the English ‘as...as...’. the negation of the construction is formed by prefixing the negator ma^{31} to the predicative adjective as shown in (1b). The NP standard and the marker $a^{31}\epsilon y^{31}$ can be analyzed as an adverbial structure modifying the parameter.

The marker $a^{31}\epsilon y^{31}$ contains elements of obscure etymology. The origin of a^{31} is very grammaticalization that it is no longer traceable, while ϵy^{31} is etymologically transparent. Its original meaning is the verb ‘like’, as shown in (2a).

- (2)a. $a^{55} ko^{31}$ $a^{33}zi^{33}-di^{31}$ ϵy^{31} .
 Ago Ayi-PAT look.like
 ‘Ago looks like Ayi.’
- b. $a^{55} ko^{31}$ $yui^{33}ya^{33}$ $?a^{31}$ $a^{31}\epsilon y^{31}$.
 Ago swim fish like
 ‘Ago swims like a fish.’

It seems that equative construction can be expressed in a way similar to similitive construction to some extent. Equative standard marker can also be used for similarity of manner. As shown in (2b), The marker $a^{31}\epsilon y^{31}$ is a postpositional phrase to serve as adjunct of the main predicate ‘swim’.

Semantically, there exist ‘at least’ interpretation in the equative construction of Type 1. Let us see a dialogue as follows.

- (3) a. $a^{55} ko^{31}$ $a^{33}zi^{33}$ $a^{31}\epsilon y^{31}$ $?mu^{55}$ mu^{31} .
 Ago Ayi PARTICLE tall EVI
 ‘Ago is as tall as Ayi.’
- b. ηa^{55} $a^{31}mu^{55}$, $a^{55} ko^{31}$ li^{55} $tehe^{55}$ $?mu^{55}$ dzi^{55} mu^{31} .
 yes EVI Ago even a bit tall more Ago
 ‘Yes, in fact Ago is a bit taller (than Ayi)’.

From the positive answer as shown in (3b), we can confirm that the proposition of (3a) is true. To be at least as tall as Ayi is to be exactly as tall as Ayi, which means that the ‘at least’ interpretation of this equative construction entails its ‘exactly’ interpretation.

2.2 .Type 2: [COMPAREE & STANDARD] + *ha*³³*ɛy*³¹*ɛy*³¹ + PARAMETER

This is an equative construction that contains a gradable adjective with an equative degree-marker *ha*³³*ɛy*³¹*ɛy*³¹ (‘identically’) and a single conjoined argument (the comparee and standard referents are combined). As is illustrated in sentence (4), the main predicate *ʔmu*⁵⁵ ‘tall’, is modified by the degree marker *ha*³³*ɛy*³¹*ɛy*³¹ ‘identical’. The comparee and the standard are combined together by the conjunction *le*³³ ‘and’ as in sentence (4a) or the comparee and the standard are a single conjoined nominal as in sentence (4b); therefore, no standard-marker is needed in this case.

- (4) a. *a*⁵⁵ *ko*³¹ *le*³³ *a*³³*i*³³ *ha*³³*ɛy*³¹*ɛy*³¹ *ʔmu*⁵⁵.
- Ago and Ayi identically tall
 ‘Ago and Ayi are identically tall.’
- b. *u*³³ - *tɕa*³³ *nu*³¹ - *ma*⁵⁵ *ha*³³*ɛy*³¹*ɛy*³¹ *ʔmu*⁵⁵.
- 3sg-PL two- CL identically tall
 ‘they(the two) are identically tall.’
- c. *a*⁵⁵ *ko*³¹ *le*³³ *a*³³*i*³³ *ha*³³*ɛy*³¹*ɛy*³¹ *mɛ*³¹.
- Ago and Ayi identically pretty
 ‘Ago and Ayi are identically pretty.’

There is something in common with adjectives in the two types listed above , that is, the adjective is used as head of the predicate and the patterns are fully productive, in the sense they can occur with a wide range of property concepts, namely, the adjective in Type 1 and Type 2 can be any gradable adjective, such as *tall*, *wide*, *long*, *pretty*, *clever*, *fast*, etc. The other two types of equative construction that will be analyzed below are only limited to certain adjectives : There are special requirements for the sub-category of adjective. For details, see the following analysis.

3.3.Type 3: [COMPAREE & STANDARD] + *ha*³³-A-A

This type is similar to type 2, i.e. the comparee and the standard are a single conjoined argument, and the gradable adjective *ʔmu*³³ ‘tall’ is the main predicate, but the form of the parameter is slightly different . The adjective should be reduplicated and the form should be

changed ($\text{ʔmu}^{55} \rightarrow \text{ʔmu}^{33}$) in this construction, as shown in (5). More specifically, this equative construction employs the form of ha^{33} -A-A, which has the same meaning of $ha^{33}\text{ʔy}^{33}\text{ʔy}^{31}+A$. The difference between them is that the adjective in “ ha^{33} -A-A” must be dimensional adjectives, such as *tall*, *wide*, *long*, etc, while the adjective in “ $ha^{33}\text{ʔy}^{33}\text{ʔy}^{31}+A$ ” can be any gradable adjective, such as *pretty*, *kind*, *brave*, etc.

- (5) $a^{55} \text{ko}^{31} \text{le}^{33} a^{33}\text{ʔi}^{33} \quad ha^{33}\text{ʔmu}^{33}\text{ʔmu}^{33}$
 Ago and Ayi identically-tall-tall
 ‘Ago and Ayi are identically tall.’

The dimensional adjectives which appear in this construction have morphological change (the tone and the initial consonant differ from the source forms). We classify the source forms as positive adjectives, and the dimensional adjectives which phonetically change as equative adjectives. The specific rule of the morphological change is exemplified as follows.

Table I dimensional adjective of Lalo Yi

meaning	positive adjectives	equative adjectives	the final forms
‘tall’(高)	ʔmu^{55}	ʔmu^{33}	$ha^{33}\text{ʔmu}^{33}\text{ʔmu}^{33}$
‘big’ (大) ¹	yu^{31}	xu^{33}	$ha^{33}\text{xu}^{33}\text{xu}^{33}$
‘big’ (大)	ʔe^{31}	ʔe^{33}	$ha^{33}\text{ʔe}^{33}\text{ʔe}^{33}$
‘long’ (长)	ʃɿ^{55}	ʃɿ^{33}	$ha^{33}\text{ʃɿ}^{33}\text{ʃɿ}^{33}$
‘far’ (远 ²)	ʃɿ^{55}	ʃɿ^{33}	$ha^{33}\text{ʃɿ}^{33}\text{ʃɿ}^{33}$
‘many’(个数多 ³)	ma^{55}	ma^{33}	$ha^{33}ma^{33}ma^{33}$
‘thick’ (厚)	$th\mu^{55}$	$th\mu^{33}$	$ha^{33}th\mu^{33}th\mu^{33}$
‘thick’ (粗)	ta^{33}	ta^{33}	$ha^{33}ta^{33}ta^{33}$

As we can see from the above table, the tonal patterns of the derived forms are completely regular: (1) The tone changes from 55 to 33; (2) The initial consonant in a few cases change ,for example, /y/ instead of /x/.we can draw such a conclusion that the prominent reason of morphological change is all out of phonological harmony, i.e. the tone of

¹ yu^{31} can refer to the age, contains the meaning of growing up, so $ha^{33}\text{xu}^{33}\text{xu}^{33}$ can both refer to the same age or the same height.

² the concept ‘far’ which expresses the distance between two points is equivalent to ‘long’, so ‘long’ and ‘far’ are homophonic. However, the ‘near’ of the distance and the ‘short’ of the object are expressed in different words.

³ The most common meaning of ma^{55} is general quantifier (Chinese :个). The semantics of $ha^{33}ma^{33}ma^{33}$ is ‘the same in quantity’.

the following words is consistent with the previous words . *ha*³³ is a root which expresses degree. If the word lined next to *ha*³³ is a dimensional adjective, it must be the equative form (reduplicate and change tone to 33) and expresses the equative meaning. If the following word is other adjective rather than the dimensional adjective, it expresses the positive reading as shown in the following example.

(6) a⁵⁵ ko³¹ ha³³ tsh⁵⁵ tha³¹.

Ago very fat

‘Ago is very fat.’

Liu et. al.(2012) mentioned the case of phonological alternative about equative adjectives which distinguish them from other positive dimensional adjectives in Nuosu Yi. For example, the positive forms of *long*, *many*, *big* are *a*³³*so*³³, *a*³³*ŋi*³³, *a*³³*ɲɿ*³³, while the equative forms are respectively *so*²¹, *ŋi*²¹, *ɲɿ*²¹. Only dimensional adjectives have the form of equative adjectives. This phenomenon is also common in other Tibeto-Burman languages, such as Lahu , Lisu, and Hani (Matisoff 1973; Bradley 1995).

Type 4: COMPAREE + STANDARD+PARAMETER+ *dzu*⁵⁵

In this type, equality is expressed by a verb (generally transitive) that expresses a notion of ‘possessing’, with the comparee as subject and the standard as second argument. The parameter is expressed in some other way: an abstract nominalized form derived from dimensional property , as illustrated in sentence(7).

(7) a⁵⁵ ko³¹ a³³*ɲi*³³ ʔmu³³*ɲɿ*³¹ dzu⁵⁵.

Ago Ayi height have

‘Ago equals Ayi in height.’

The main predicate of (7) is the verb *dzu*⁵⁵ ‘have’. The parameter is provided by the derived noun ʔmu³³*ɲɿ*³¹ ‘height’, which introduces the standard at the same time. Here the parameter is expressed by an abstract noun which consists of a root derived from an equative adjective ʔmu³³, and a nominalizer *ɲɿ*³¹ which specifically nominalizes the dimensional adjectives.

This equative construction is only available for the words which express the property of dimension as its parameter, so the forms of the dimensional adjectives are similar to type 3, and the number of adjectives has increased from eight to eleven.

Table II the derived nouns of Lalo Yi

meaning	The source forms (positive adjectives)	meaning	The final forms (derived nouns)
‘tall’(高)	<i>ʔmu</i> ⁵⁵	‘height’	<i>ʔmu</i> ³³ <i>sɿ</i> ³¹
‘big’ (大)	<i>yu</i> ³¹	‘height’	<i>xu</i> ³³ <i>sɿ</i> ³¹
‘big’ (大)	<i>ʔe</i> ³¹	‘size’	<i>ʔe</i> ³³ <i>sɿ</i> ³¹
‘long’ (长)	<i>ʃɿ</i> ⁵⁵	‘length’	<i>ʃɿ</i> ³³ <i>sɿ</i> ³¹
‘far’ (远)	<i>ʃɿ</i> ⁵⁵	‘length’	<i>ʃɿ</i> ³³ <i>sɿ</i> ³¹
‘many’(个数多)	<i>ma</i> ⁵⁵	‘amount’	<i>ma</i> ³³ <i>sɿ</i> ³¹
‘thick’ (厚)	<i>thɰ</i> ⁵⁵	‘thickness’	<i>thɰ</i> ³³ <i>sɿ</i> ³¹
‘thick’ (粗)	<i>ta</i> ³³	‘thickness’	<i>ta</i> ³³ <i>sɿ</i> ³¹
‘deep’ (深)	<i>ni</i> ³¹	‘depth’	<i>ni</i> ³¹ <i>sɿ</i> ³¹
‘heavy’ (重)	<i>ʔlu</i> ³¹	‘weight’	<i>ʔlu</i> ³¹ <i>sɿ</i> ³¹
‘wide’ (宽)	<i>khuan</i> ³³	‘width’	<i>khuan</i> ³³ <i>sɿ</i> ³¹

The words which are listed above with tonal change (the first seven listed in table II) or original tone (the last four in table II) can appear in the equative construction of type 4. Interestingly, it can even form a fixed form containing a Chinese loan for *width* (*khuan*³³ *sɿ*³¹).

- (8) a. *lu*⁵⁵ *dɛ*³³ *a*⁵⁵ *tʃhɿ*³¹ *tu*³¹ *na*⁵⁵ *tʃhɿ*³¹ *tu*³¹ *khuan*³³ *sɿ*³¹ *dzu*⁵⁵.
wall this one Cl that one Cl width have
‘This wall equals that wall in width.’
- b. *u*³³ *dɛ*⁵⁵ *dzi*³ *phi*³¹ *ŋa*⁵⁵ *ma*³³ *sɿ*³¹ *dzu*⁵⁵.
3sg-GEN money 1sg amount have
‘She has as much money as mine.’

*khuan*³³ *sɿ*³¹ which is used in (8a) represents the width of the wall, likewise, *ma*³³ *sɿ*³¹ represents the amount of money in (8b). Type 4 is only available for dimensional adjectives, and their corresponding negative forms cannot be used in this equative construction.

In Lalo Yi, the form of a wh-question expressing weights and measures adopts the derived noun which stems from the dimensional adjective. Relevant examples are given below.

- (9) A: tɕhɿ³³ tɕhɿ⁵⁵ khuu⁵⁵ a³¹da⁵⁵ ʔɛ³³sɿ³¹ dzu⁵⁵ u⁵⁵?
 deer DEM Cl what size have Q
 ‘How big is this deer?’
- B: ʔu³¹ a⁵⁵nuu³¹ tɕhɿ⁵⁵ khuu⁵⁵ ʔɛ³³sɿ³¹ dzu⁵⁵ mu³¹
 1pl cattle DEM Cl size have EVI
 ‘The deer is approximately the same size as our cattle.’

Matisoff(1973) originally mentions the term *extensive* to refer to this class of forms (dimensional adjectives and the derived forms), and discusses their syntax in considerable detail. In the Lahu language, the basic forms, that is, dimensional adjectives are *ma*⁵³ ‘many’, *tɕ*¹¹² ‘big’, *ʋtɕ*³³ ‘far’, and the derived forms are respectively *ma*³³, *htɕ*³³, *ftɕ*³³. Bradley(1995) examines this phenomenon broadly in Tibeto-Burman languages including Nuosu, Lahu, Lisu, Lipo, Pula, Akha, Nasu, and Sami. The study finds that there are interrogative, adverbial and nominal forms derived from the positive *extensives*, and these show tonal and in a few cases initial consonant differences from the source forms. We argue that these changes appear to be triggered by the requirement to express something about a gradable property to the same degree or a notion of ‘reaching’ or ‘equaling’, and the interrogative form is one of the outward representation. As shown in (9), there is a scenario of interrogative form about size. In the question-and-answer, we can see that it expresses a concept of the equality. In a given situation of no ability to make accurate measurement or no need accurate measurement, people measure one object on the basis of another object which they are familiar with. For example, deer is rare in the village where Lalo speakers live, so they take the cattle which they are familiar as the standard, as shown in (9).

The main predicate *dzu*⁵⁵ in this equative construction is a verb which means a notion of ‘reaching’ or ‘equaling’, so we can say that the equative meaning which the equative construction expresses is a dynamic rising process, that is, the value denotes a range. Specifically, suppose that ‘Ago’ is 1.70 meters tall and ‘Ayi’ is 1.68 meters tall, we can say ‘Ayi equals Ago in height’ as shown in (10b), but not ‘Ago equals Ayi in height’, see (10a).

(10) *a. a⁵⁵ ko³¹ a³³zi³³ ʔmu³³ʃ³¹ dzu⁵⁵.

Ago Ayi height have
 ‘Ago equals Ayi in height.’

b. a³³zi³³ a⁵⁵ ko³¹ ʔmu³³ʃ³¹ dzu⁵⁵.

Ayi Ago height have
 ‘Ayi equals Ago in height.’

If ‘Ago’ is 1.70 meters tall and ‘Ayi’ is 1.70 meters tall, both (10a) and (10b) are true. It means that there is an ‘at most’ interpretation in Type 4.

3. Conclusion

There are four different types of equative construction in Lalo Yi. The equative construction of Type1 in Lalo Yi would belong neither to Haspelmath’s Type 1 (only equative standard marker) nor Type 2 (both equative degree-marker and standard-marker), for in Lalo Yi *a³¹ɛy³¹* can be viewed as either a standard marker or a parameter marker. It may contribute a new type of equative construction (with the standard marker and the parameter marker fused). The equative construction of Type 2 and Type 3 in Lalo Yi basically correspond to Haspelmath’s Type 3 (Equative degree-marker unified, i.e. an predicative parameter with an equative degree-marker and the comparee and standard referents are unified), and the last type which has the verb *dzu⁵⁵* as the main predicate in Lalo Yi approximately meets Haspelmath’s Type 4 (Primary reach equative, i.e. with a verb as its primary predicate which expresses a notion of ‘reaching’ or ‘equaling’ , the comparee as subject and the standard as second argument).

There are three different ways to encode ‘parameter’ in Lalo Yi: bare adjectives (see Type 1 and Type 2), reduplicative adjectives (see Type 3), and derived nouns (see Type 4). Type 3 and type 4 are only available for the forms with dimensional property as their parameter. We classify the first two types as general equative construction, for they are open to any adjective , and the latter two as specific equative construction, for they are limited to the forms which contain dimensional property.

There are subtle semantic differences between the equative construction of differentiated comparee and standard (see Type 1 and Type 4) and the unified comparee and standard(see Type 2 and Type 3) in Lalo Yi . The forms of unified comparee and standard just has an

‘exactly’ reading, while the forms of differentiated comparee and standard, like Type 1, has an ‘at least’ reading, and Type 4 has an ‘at most’ interpretation.

References

- Bradley, David. 1995. Grammaticalisation of Extent in Mran-Ni. *Linguistics of the Tibeto-Burman Area* 18(1).1-15.
- Chen, Shilin, Shiming Bian and Xiuqing Li. 1985. *Yiyu jianzhi* [A brief description of the Yi language]. Beijing: Nationalities Press.
- Chirkova, Katia. 2018. *Comparative, equative, and similitive constructions in Lizu (Tibeto-Burman)*. <https://hal.archives-ouvertes.fr/hal-01684115>
- Garner, Matthias. 2013. *A Grammar of Nuosu*, Berlin: De Gruyter Mouton.
- Haspelmath, Martin. 2017. Equative constructions in world-wide perspective. In Yvonne Treis and Martine Vanhove (eds.), *Similitive and Equative Constructions: A Cross-linguistic Perspective*, 9-32. Amsterdam/Philadelphia: John Benjamins.
- Haspelmath, Martin. and Oda Buchholz. 1998. Equative and similitive constructions in the languages of Europe. In Johan van der Auwera (ed.), *Adverbial Constructions in the Languages of Europe*, 277-334. Berlin: Mouton de Gruyter.
- Henkelmann, Peter. 2006. Constructions of equative comparison. *Language Typology and Universals* 59(4). 370-398.
- Huang, Chenglong. 2006. *Puxi Qiangyu Yanjiu [Studies on Puxi Qiang]*. Beijing: Nationalities Press.
- Li, Charles and Sandra Thompson. 1981. *Mandarin Chinese: A Functional Reference Grammar*, Berkeley: University of California Press.
- Liu, Hongyong, Xiao Li and Seunghun Lee. 2012. Liangshang yiyu chabiju de xingtaijufa he yuyi [The Morphosyntactic Features and Semantic of Nuosu Yi Comparative Clauses]. *Journal of Sino-Tibetan Linguistics* 7:44-53.
- Matisoff, James. 1973. *A Grammar of Lahu*. Berkeley: University of California Press.
- Yang, Cathryn. 2010. *Lalo regional varieties: Phylogeny, dialectometry, and sociolinguistics*. Melbourne: La Trobe University Ph.D. dissertation.